IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Applicant(s): K.S. Grant et al.
Docket No.: 1-2-27
Serial No.: 10/689,090
Filing Date: October 20, 2003
Group: 2616
Examiner: Wanda Z. Russell

Title: Traffic Management Using In-Band Flow Control and Multiple-Rate Traffic Shaping

---

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicants (hereinafter "Appellants") hereby appeal the final rejection dated July 21, 2008 of claims 1-20 of the above-identified application.

REAL PARTY IN INTEREST

The present application is assigned of record to Agere Systems Inc. On April 2, 2007, the assignee Agere Systems Inc. completed a merger with LSI Logic Corporation, with the resulting entity being named LSI Corporation. LSI Corporation is the real party in interest.

RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences.

STATUS OF CLAIMS

The present application was filed on October 20, 2003, with claims 1-20. Claims 1-20 remain pending. Claims 1 and 18-20 are the independent claims.

Claims 1-8, 11 and 14-20 are rejected under 35 U.S.C. §102(e). Claims 9, 10, 12 and 13 are rejected under 35 U.S.C. §103(a). Claims 1-20 are appealed.

STATUS OF AMENDMENTS

There have been no amendments filed subsequent to the final rejection.

SUMMARY OF CLAIMED SUBJECT MATTER

Independent claim 1 is directed to a method for providing backpressure information from a physical layer device to a link layer device in a communication system. The method includes the steps of generating a flow control message in the physical layer device responsive to a detected condition relating to at least a given one of a plurality of egress queues of the physical layer device; and transmitting the flow control message from the physical layer device to the link layer device. The flow control message comprises backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message over an interface between the physical layer device and the link layer device. The link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

An illustrative embodiment includes a method for providing backpressure information from a physical layer device (e.g., 104 in FIG. 1) to a link layer device (e.g., 102 in FIG. 1) in a communication system (e.g., 100 in FIG. 1), as described in the specification at, for example, page 6, lines 14-21. As described in the specification at, for example, page 10, line 12, to page 11, line 11; page 14, lines 23-28, with reference to FIG. 6; and page 16, lines 5-8, with reference to FIG. 7, the method includes the steps of generating a flow control message in the physical layer device responsive to a detected condition relating to at least a given one of a plurality of egress queues (e.g., 632 in FIG. 6 and/or 732 in FIG. 7) of the physical layer device and

transmitting the flow control message from the physical layer device to the link layer device, wherein the flow control message comprises backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message over an interface (e.g., 105 in FIG. 1, 624 in FIG. 6, and/or 724 in FIG. 7) between the physical layer device and the link layer device. As described in the specification at, for example, page 12, line 4, to page 13, line 22, with reference to FIG. 5, the link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

Independent claim 18 is directed to an apparatus for use in generating backpressure information for transmission to a link layer device in a communication system. The apparatus comprises a physical layer device which is connectable to the link layer device. The physical layer device is operative to generate a flow control message responsive to a detected condition relating to at least a given one of a plurality of egress queues of the physical layer device, wherein the flow control message comprises backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message over an interface between the physical layer device and the link layer device. The link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

As described in the specification at, for example, page 6, lines 14-21, an illustrative embodiment includes an apparatus for use in generating backpressure information for transmission to a link layer device (e.g., 102) in a communication system (e.g., 100); the apparatus comprises a physical layer device (e.g., 104) which is connectable to the link layer device. As described in the specification at, for example, page 10, line 12, to page 11, line 11; page 14, lines 23-28, with reference to FIG. 6; and page 16, lines 5-8, with reference to FIG. 7, the physical layer device is operative to generate a flow control message responsive to a detected condition relating to at least a given one of a plurality of egress queues (e.g., 632 in FIG. 6 and/or 732 in FIG. 7) of the physical layer device, wherein the flow control message comprises

backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message over an interface (e.g., 105 in FIG. 1, 624 in FIG. 6, and/or 724 in FIG. 7) between the physical layer device and the link layer device. As described in the specification at, for example, page 12, line 4, to page 13, line 22, with reference to FIG. 5, the link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

Independent claim 19 is directed to an apparatus for use in processing backpressure information received from a physical layer device in a communication system. The apparatus comprises a link layer device connectable to the physical layer device. The link layer device is operative to receive from the physical layer device a flow control message responsive to a detected condition relating to at least a given one of a plurality of egress queues of the physical layer device, wherein the flow control message comprises backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message over an interface between the physical layer device and the link layer device. The link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

As described in the specification at, for example, page 6, lines 14-21, an illustrative embodiment includes an apparatus for use in processing backpressure information received from a physical layer device (e.g., 104) in a communication system (e.g., 100); the apparatus comprises a link layer device (e.g., 102) connectable to the physical layer device. As described in the specification at, for example, page 10, line 12, to page 11, line 11; page 14, lines 23-28, with reference to FIG. 6; and page 16, lines 5-8, with reference to FIG. 7, the link layer device is operative to receive from the physical layer device a flow control message responsive to a detected condition relating to at least a given one of a plurality of egress queues (e.g., 632 in FIG. 6 and/or 732 in FIG. 7) of the physical layer device, wherein the flow control message comprises backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message

over an interface (e.g., 105 in FIG. 1, 624 in FIG. 6, and/or 724 in FIG. 7) between the physical layer device and the link layer device. As described in the specification at, for example, page 12, line 4, to page 13, line 22, with reference to FIG. 5, the link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

Independent claim 20 is directed to a method for providing multiple-rate traffic shaping in a link layer device in a communication system. The method comprises a step of receiving from a physical layer device of the system a flow control message responsive to a detected condition relating to at least a given one of a plurality of egress queues of the physical layer device. The method comprises selecting one of a plurality of available traffic shaping characteristics for utilization with a given channel between the link layer device and the physical layer device based at least in part on the flow control message. The link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

An illustrative embodiment includes a method for providing multiple-rate traffic shaping in a link layer device (e.g., 102 in FIG. 1) in a communication system (e.g., 100 in FIG. 1), as described in the specification at, for example, page 6, lines 14-21. As described in the specification at, for example, page 10, line 12, to page 11, line 11; page 14, lines 23-28, with reference to FIG. 6; and page 16, lines 5-8, with reference to FIG. 7, the method comprises a step of receiving from a physical layer device (e.g., 104 in FIG. 1) of the system a flow control message responsive to a detected condition relating to at least a given one of a plurality of egress queues (e.g., 632 in FIG. 6 and/or 732 in FIG. 7) of the physical layer device. As described in the specification at, for example, page 12, line 4, to page 13, line 22, with reference to FIG. 5, the method comprises selecting one of a plurality of available traffic shaping characteristics for utilization with a given channel between the link layer device and the physical layer device based at least in part on the flow control message, and the link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

Illustrative embodiments of the present invention provide a number of significant advantages over conventional arrangements. As discussed in the specification at, for example, page 4, lines 4-8; page 10, lines 12-19; and page 18, line 27, to page 19, line 5, the variation in packet overhead associated with various applications is compensated using in-band flow control and multiple-rate traffic shaping techniques, which may be provided using a standard interface between a link layer device and a physical layer device, such as an SPI-3 interface.

Advantageously, these techniques in the illustrative embodiments provide a backpressure mechanism that may be used to throttle the flow of data from a link layer device to a physical layer device during times of high packet overhead to avoid egress queue overruns in the physical layer device. During periods in which backpressure is detected, any data destined to a backpressured egress queue of the physical layer device may accumulate in the relatively large buffer space of the link layer device and can be processed using the traffic management capabilities of the link layer device.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Claims 1-8, 11 and 14-20 are rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent Publication No. 2002/0176357 (hereinafter "Lay").

2. Claims 9 and 10 are rejected under 35 U.S.C. §103(a) as being unpatentable over Lay in view of U.S. Patent Publication No. 2005/0278503 (hereinafter "McDonnell").

3. Claims 12 and 13 are rejected under 35 U.S.C. §103(a) as being unpatentable over Lay in view of U.S. Patent Publication No. 2002/0075540 (hereinafter "Munter").

ARGUMENT

1. Rejection of claims 1-8, 11 and 14-20 under §102(e) over Lay

Claims 1-5, 7, 8, 11 and 14-20

Appellants initially note that the Federal Circuit has recently reiterated that "unless a reference discloses within the four corners of the document not only all of the limitations claimed but also all of the limitations arranged or combined in the same way as recited in the

claim, it cannot be said to prove prior invention of the thing claimed and, thus, cannot anticipate under 35 U.S.C. §102." *Net MoneyIN Inc. v. VeriSign Inc.*, 545 F.3d 1359, 1369, 88 USPQ2d 1751, 1760 (Fed. Cir. 2008)

In formulating the present rejection of claim 1, the Examiner argues that Lay discloses the limitations of claim 1 wherein a flow control message is generated in the physical layer device and transmitted from the physical layer device to the link layer device. Specifically, the Examiner contends that gigabit interface 104 in FIG. 1 is a physical layer device which generates a flow control message, which is then transmitted to a flow control manager 116 allegedly located in the MAC of ports 102(1)-102(12).

In arguing that gigabit interface 104 is a physical layer device which generates a flow control message, the Examiner relies primarily on paragraph [0031] of Lay:

> Gigabit interface 104, like ports 102(1)-102(12), has a PHY, a Gigabit Media Access Controller (GMAC) and a latency block. The GMAC can be a fully compliant IEEE 802.3z MAC operating at 1 Gbps full-duplex only and can connect to a fully compliant GMII or TBI interface through the PHY. In this example, GMAC 108 provides full-duplex flow control mechanisms and a low cost stacking solution for either twisted pair or TBI mode using in-band signaling for management.

Appellants respectfully submit that the relied-upon portion of Lay in fact discloses that gigabit interface 104, like ports 102(1)-102(12), comprises a physical layer device (PHY) and a link layer device (GMAC). It should be noted that FIG. 1A of Lay shows a plurality of ports 102(1)-102(12), each of which comprises a physical layer device (physical element PHY) and a link layer device (Media Access Controller MAC); see also Lay at [0026] and [0027].

Moreover, because the GMAC can only connect to a fully compliant GMII or TBI interface through the PHY, the GMAC is not a device which provides an interface between a link layer device and a physical transmission medium of a network-based system. Accordingly, the GMAC is not a physical layer device. Thus, even if the disclosure of Lay at [0031] of a GMAC which provides full-duplex flow control mechanisms could be construed as teaching that a GMAC within gigabit interface 104 generates a flow control message, this would nonetheless

fail to teach or even suggest the limitation wherein a flow control message is generated in the physical layer device.

Appellants respectfully submit that the new embodiment of Lay relied upon in the present rejection fails to disclose the aforementioned limitations of claim 1 for reasons similar to those presented in Appellants' response filed January 9, 2008, which the Examiner deemed persuasive. See the Office Action dated February 4, 2008, at page 5, first paragraph.

The Examiner further contends that a comparison of paragraph [0028], lines 1-4 ("Flow control is provided by each of the MACs" located in the ports), and paragraph [0039], lines 1-2 ("Switch 100, in one example of the invention, has a Flow Control Manager 116 that manages the flow of packet data") indicates that Flow Control Manager 116 is located in the MAC of a port. Appellants respectfully disagree and instead submit that the MACs within port 102(1)-102(12) and the Flow Control Manager 116 are instead distinct components of switch 100 each of which are involved in flow control.

Additional evidence may be found in FIG. 1A of Lay, which clearly shows Flow Control Manager 116 as being a distinct component rather than located within the MACs of ports 102(1)-102(12). Moreover, even if FIG. 1A of Lay could be characterized as "a functional drawing, not a physical layout," as alleged by the Examiner on page 10 of the final Office Action, Lay at [0051]-[0052] clearly describes the physical interconnections between switch components, and hence describes the physical layout of the switch: "Each of the transmit (TX) and receive (RX) portions of ports 102(1)-102(12) are connected to the PBM Bus, ATM Bus, and TXM Bus for communications with other components of the switch. . . . [The Flow Control Manager 116 is] also connected to the ATM Bus for communications with other portions of the switch."

In the Advisory Action at page 2, last paragraph, the Examiner argues that "Lay teaches that FM 120 is connected to each of the ports 102(1)-102(12) directly and is also connected to the ATM Bus for communications with other portions of the switch. Note that the fact of FM 120 is connected to each of the ports is not illustrated in Fig. 1, and the figure only shows that 120 is connected to 108, same connection for the Flow Control Manager 116. There is no evidence showing that the 116 is not connected to the ports." (internal citations omitted)

Appellants are not arguing that Flow Control Manager 116 is not connected to the ports; as noted above, the Flow Control Manager is connected to the ports via the ATM Bus. Rather, Appellants respectfully submit that Flow Control Manager 116 is not located in the ports, but rather is a distinct component. The Examiner's arguments regarding the allegedly analogous relationship between Forwarding Manager 120 and the ports only help bolster Appellants' case.

Independent claim 1 recites further limitations wherein the flow control message is responsive to a detected condition relating to at least a given one of a plurality of egress queues of the physical layer device and wherein the link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to backpressure information in the flow control message.

It should be noted that the present specification at page 8, lines 24-27, with reference to FIG. 1, specifies that "the term 'egress' refers in the illustrative embodiments to the direction of data transfer from the network 108 to user equipment. The egress direction relative to the PLD 104 is thus the direction of data transfer from the PLD interface with the LLD 102 to the PLD interface with the transceiver 106."

The Examiner argues that these limitations are met by Lay at [0028], which the Examiner characterizes as "describing flow control related to [a] backpressure scheme," and [0077], which the Examiner characterizes as describing "setting thresholds - alter a characteristic of a flow."

Appellants respectfully submit that, rather than teaching the claimed techniques wherein a flow control message is responsive to a detected condition relating to an egress queue of a physical layer device and wherein the link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to backpressure information in the flow control message, the flow control described by Lay is directed to managing the flow of incoming data packets from the ports of a switch to a memory of the switch. See Lay at [0028] (with emphasis added) ("Flow control is provided by each of the MACs. When flow control is implemented, the flow of incoming data packets is managed or controlled to reduce the chances of system resources being exhausted.")

Furthermore, even if the disclosure of Lay at [0077] directed to "setting thresholds" could be characterized as "alter[ing] a characteristic of a flow," claim 1 specifies that the link layer

device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device. The thresholds taught by Lay, by contrast, specify conditions under which a flow of incoming data packets from the ports of a switch to a memory of the switch should be altered. See, e.g., Lay at [0077] (a low threshold can "indicate when FCM 116 should send a message to the ports when to slow down the sending of packet data to memory and a high threshold" can "indicate when FCM 116 should send a command to AM 122 to start dropping packets.")

See generally Lay at [0039] ("Switch 100 . . . has a Flow Control Manager 116 that manages the flow of packet data. As each port sends more and more data to the switch, Flow Control Manager 116 can monitor the amount of memory being used by each port 102(1)-102(12) of switch 100 and the switch as a whole.") and Lay at [0074] (Flow Control Manager (FCM) 116 "monitors the ATM Bus to determine how much memory is being used to store data and how much memory is free for storing data. Based on this information, FCM 116 can send commands to each port . . . . requesting that the port slow down the sending of packet data to memory.")

In the Advisory Action on page 3, third paragraph, the Examiner responds to the above argument by arguing that the "[c]laim language lacks the details of the egress queues (structural and functional). Even though the limitations is read in light of the specification, limitations are not read into the claims."

Appellants respectfully note it is axiomatic that "a patentee is free to act as his own lexicographer, and may set forth any special definitions of the claim terms in the patent specification or file history, either expressly or impliedly." *Schoenhaus v. Genesco, Inc.*, 440 F.3d 1354, 1358, 78 USPQ2d 1252, 1255 (Fed. Cir. 2006). Accordingly, where a definition is provided by the applicant for a term, either explicitly or by implication (i.e., according to the usage of the term in the context in the specification), that definition will control interpretation of the term as it is used in the claim. See *Vitronics Corp. v. Conceptronic Inc.*, 90 F.3d 1576, 1583, 39 USPQ2d 1573, 1577 (Fed. Cir. 1996); see generally *Phillips v. AWH Corp.*, 415 F.3d 1303, 75 USPQ2d 1321 (Fed. Cir. 2005) (*en banc*).

Accordingly, Appellants' reliance on the specification's definitions of such claim terms as "physical layer device," "link layer device," and "egress," is not an impermissible attempt to read limitations from the specification into the claims, but rather is interpreting the claim in light of the specification. See, e.g., *Constant v. Advanced Micro-Devices, Inc.*, 848 F.2d 1560, 1572, 7 USPQ2d 1057, 1065 (Fed. Cir. 1988) (If "words that are used in the claims [are] defined in the specification," these definitions from the specification "must be imported into the claims to give meaning to disputed terms.")

In view of the above, Lay fails to teach, or even suggest, the limitations of claim 1.

Independent claims 18-20 include limitations similar to those discussed above with regard to independent claim 1 and thus believed to be patentable for at least the reasons identified above in reference to claim 1.

Dependent claims 2-5 and 7-17 are believed allowable for at least the reasons identified above with regard to independent claim 1, from which they depend.

Claim 6

Dependent claim 6 is believed allowable for at least the reasons identified above with regard to independent claim 1, from which it depends. Moreover, claim 6 is believed to define separately patentable subject matter. Specifically, claim 6 includes a limitation wherein the flow control message comprises a logical MPHY value corresponding to the given queue.

As described in the specification at, for example, page 1, lines 24-26, an MPHY is one of the multiple channels over which a multiple-port physical layer device may communicate with a link layer device. See also page 11, lines 8-10. As described in the specification at, for example, page 5, line 22, to page 6, line 5, the inclusion of the logical MPHY value in the flow control message provides a number of advantages.

The Examiner contends that this limitation is met by Lay at [0070], lines 4-7, which the Examiner argues "teaches multiple port logical values." See final Office Action at page 10 and the Advisory Action at page 3, sixth paragraph. Appellants note that the relied-upon portion of Lay discloses that "TXM Memory is allocated on a per port basis so that if there are ten ports there are ten queues within the TXM Memory allocated to each port."

Appellants respectfully submit that the relied-upon portion of Lay fails to disclose the limitation of dependent claim 6 wherein the flow control message comprises a logical MPHY value corresponding to the given queue.

2. Rejection of claims 9 and 10 under §103(a) over Lay and McDonnell

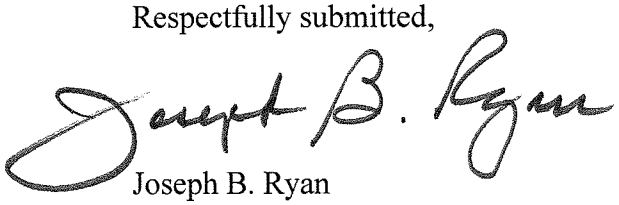
Claims 9 and 10 are patentable at least by virtue of their dependency from claim 1, the patentability of which is described above. Appellants further submit that McDonnell fails to remedy the above-noted deficiency of Lay with regard to the limitations of claim 1.

3. Rejection of claims 12 and 13 under §103(a) over Lay and Munter

Claims 12 and 13 are patentable at least by virtue of their dependency from claim 1, the patentability of which is described above. Appellants further submit that Munter fails to remedy the above-noted deficiency of Lay with regard to the limitations of claim 1.

In view of the above, Appellants believe that claims 1-20 are in condition for allowance, and respectfully request the reversal of the present rejections.

Respectfully submitted,



Date: December 22, 2008

Joseph B. Ryan
Attorney for Appellant(s)
Reg. No. 37,922
Ryan, Mason & Lewis, LLP
90 Forest Avenue
Locust Valley, NY 11560
(516) 759-7517

CLAIMS APPENDIX

1. A method for providing backpressure information from a physical layer device to a link layer device in a communication system, the method comprising the steps of:

generating a flow control message in the physical layer device responsive to a detected condition relating to at least a given one of a plurality of egress queues of the physical layer device; and

transmitting the flow control message from the physical layer device to the link layer device;

wherein the flow control message comprises backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message over an interface between the physical layer device and the link layer device; and

wherein the link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

2. The method of claim 1 wherein the given queue has an upper threshold and a lower threshold associated therewith, corresponding to respective fullness levels of the queue.

3. The method of claim 2 wherein the flow control message comprises backpressure information indicating that the queue fullness has crossed the upper threshold from below that threshold.

4. The method of claim 2 wherein the flow control message comprises backpressure information indicating that the queue fullness has crossed the lower threshold from above that threshold.

5. The method of claim 1 wherein the flow control message comprises in addition to the backpressure information an identifier of the given queue with which the backpressure information is associated.

6. The method of claim 5 wherein the identifier comprises a logical MPHY value corresponding to the given queue.

7. The method of claim 1 wherein the flow control message identifies a particular one of a plurality of detected conditions relating to the given queue, the plurality of detected conditions comprising at least an over-threshold condition and an under-threshold condition.

8. The method of claim 7 wherein the plurality of detected conditions further comprises an empty queue condition and a full queue condition.

9. The method of claim 1 wherein the interface between the physical layer device and the link layer device comprises an SPI-3 ingress interface.

10. The method of claim 9 wherein the flow control message is transmitted at a highest priority level on the SPI-3 ingress interface between the physical layer device and the link layer device.

11. The method of claim 1 wherein the flow control message is deliverable from the physical layer device to a designated queue of the link layer device.

12. The method of claim 11 wherein the designated queue comprises a class of service (CoS) queue of the link layer device.

13. The method of claim 12 wherein the CoS queue is one of a plurality of CoS queues serviced by a quality of service (QoS) queue of the link layer device.

14. The method of claim 1 wherein the link layer device is operative to perform multiple-rate traffic shaping responsive to the backpressure information in the flow control message.

15. The method of claim 14 wherein the link layer device is operative to perform the multiple-rate traffic shaping by selecting one of a plurality of available scheduling rates for a channel associated with the egress queue of the physical layer device responsive to backpressure information in the flow control message.

16. The method of claim 15 wherein the link layer device is operative to perform the multiple-rate traffic shaping by selecting a first one of the plurality of available scheduling rates for the channel if the backpressure information indicates an under-threshold condition, and selecting a second one of the plurality of available scheduling rates for the channel if the backpressure information indicates an over-threshold condition.

17. The method of claim 16 wherein the first and second rates correspond to 100% and 80%, respectively, of a nominal High-level Data Link Control (HDLC) channel rate.

18. An apparatus for use in generating backpressure information for transmission to a link layer device in a communication system, the apparatus comprising:

a physical layer device connectable to the link layer device and operative to generate a flow control message responsive to a detected condition relating to at least a given one of a plurality of egress queues of the physical layer device, the flow control message being transmittable from the physical layer device to the link layer device;

wherein the flow control message comprises backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message over an interface between the physical layer device and the link layer device; and

wherein the link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

19. An apparatus for use in processing backpressure information received from a physical layer device in a communication system, the apparatus comprising:

a link layer device connectable to the physical layer device and operative to receive from the physical layer device a flow control message responsive to a detected condition relating to at least a given one of a plurality of egress queues of the physical layer device;

wherein the flow control message comprises backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message over an interface between the physical layer device and the link layer device; and

wherein the link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

20. A method for providing multiple-rate traffic shaping in a link layer device in a communication system, the method comprising the steps of:

receiving from a physical layer device of the system a flow control message responsive to a detected condition relating to at least a given one of a plurality of egress queues of the physical layer device; and

selecting one of a plurality of available traffic shaping characteristics for utilization with a given channel between the link layer device and the physical layer device based at least in part on the flow control message; and

wherein the link layer device is operative to alter a characteristic of a flow of data from the link layer device to the physical layer device responsive to the backpressure information in the flow control message.

EVIDENCE APPENDIX

None

RELATED PROCEEDINGS APPENDIX

None